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## EUROPEAN PATENT APPLICATION

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## (54) Switch for optical signals

(57) A cross-connect switch for switching optical signals, in particular, Dense Wavelength Division Multiplexed (DWDM) signals is disclosed. The switch includes a switching matrix for each of the predetermined wavelengths of the DWDM signals. The switching matrices include Micro-Electro-Mechanical (MEM) systems which have optically reflective elements, typically mirrors, arranged in rows and columns for switching an incoming optical signal travelling along a row of such elements to an output port aligned with a column of the elements. The switch has input demultiplexers to split

an incoming DWDM signal into its component channel wavelengths, each of which is directed to a switching matrix where it is switched to an output port and recombined into an outgoing DWDM signal by a multiplexer before being transmitted out of the switch. A wavelength-converting switch, connected across the switching matrices, is also included for switching channels between wavelengths. Thus, the switch provides port switching by virtue of the switching matrices and channel switching by virtue of the wavelength-converting switch, as well as a combination of both port and channel switching.

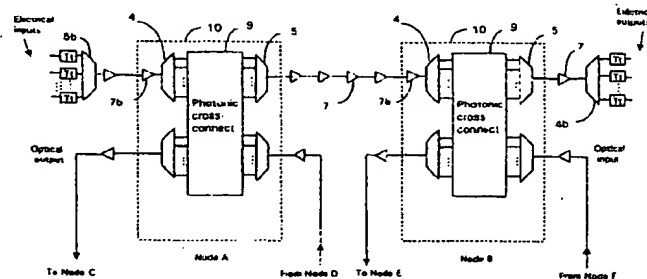


FIG. 2b



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## EUROPEAN SEARCH REPORT

Application Number  
EP 00 30 8770

## DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	WO 98 31184 A (TELLIUM INC) 16 July 1998 (1998-07-16)	1-5, 8-12, 21, 24-32	H04Q11/00 H04L12/56
Y	* page 7, line 13 - page 8, line 6 *	6,7,13	
A	* page 10, line 7 - line 21 *	14-21	
	* page 21, line 18 - page 22, line 8 *		
	* figures 10,21-23 *		
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X	EP 0 620 694 A (NIPPON ELECTRIC CO) 19 October 1994 (1994-10-19)	14-21	
Y	* column 10, line 38 - line 51 *	13	
A	* column 11, line 11 - line 58 *	1-12, 24-32	
	* figures 6,7,9 *		
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Y	EP 0 741 499 A (AT & T CORP) 6 November 1996 (1996-11-06)	6,7	
A	* figures 3,5,6 *	1-12, 14-21, 24-32	
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A	LEE K-C ET AL: "OPTIMIZATION OF A WDM OPTICAL PACKET SWITCH WITH WAVELENGTH CONVERTERS" PROCEEDINGS OF INFOCOM '95 - CONFERENCE ON COMPUTER COMMUNICATIONS. FOURTEENTH ANNUAL JOINT CONFERENCE OF THE IEEE COMPUTER AND COMMUNICATIONS SOCIETIES, BOSTON APR. 2 - 6, 1995, LOS ALAMITOS, IEEE COMP. SOC. PRESS, US, vol. 3 CONF. 14, 2 April 1995 (1995-04-02), pages 423-430, XP000580606 ISBN: 0-7803-2524-9 * figure 1 *	1-21, 24-32	TECHNICAL FIELDS SEARCHED (Int.Cl.7) H04Q
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	-/--		
-The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 12 November 2002	Examiner Meurisse, W
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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### CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

- ☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):
- ☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

### LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

- ☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.
- ☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.
- ☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:
- ☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

1-21, 24-32

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## EUROPEAN SEARCH REPORT

Application Number  
EP 00 30 8770

## DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	EP 0 721 275 A (NIPPON ELECTRIC CO) 10 July 1996 (1996-07-10) * column 4, line 4 - column 5, line 20; figures 1,2 *	1-21, 24-32	
A	US 5 878 177 A (KARASAN EZHAN ET AL) 2 March 1999 (1999-03-02) * figure 4 *	1-21, 24-32	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
<del>The present search report has been drawn up for all claims</del>			
Place of search <b>THE HAGUE</b>		Date of completion of the search <b>12 November 2002</b>	Examiner <b>Meurisse, W</b>
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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LACK OF UNITY OF INVENTION  
SHEET B

Application Number

EP 00 30 8770

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. Claims: 1-21,24-32

Optical network and cross-connect switch comprising a wavelength-converting inter-matrix switch

2. Claims: 22,23

Optical switching matrix comprising switching elements comprising a rectangular substrate and optical diverters

3. Claims: 33-41

Optical connection system comprising first and second mating inserts and an alignment ferrule

4. Claims: 42,43

Method of upgrading an optical cross-connect switch comprising the step of providing each switching matrix with an expansion port

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**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 00 30 8770

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
The members are as contained in the European Patent Office EDP file on  
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12-11-2002

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82